CLAIMS

WE CLAIM:

1. An air turbine starter comprising:

a main housing;

a turbine assembly partially disposed within the main housing, the turbine assembly including a turbine wheel having a plurality of blades circumferentially mounted thereon; and

a unitary inlet structure coupled to the main housing and substantially enclosing at least a portion of the turbine wheel, the unitary inlet structure including:

a housing section having at least an inlet, an inner surface, and a mounting surface, the mounting surface coupled to the main housing; and

a stator section integrally formed as part of the housing section, the stator section disposed at least partially within the housing section and having an outer surface,

wherein at least a portion of the housing section inner surface and at least a portion of the stator section outer surface form a flow path that fluidly couples the housing section air inlet to the turbine blades.

2. The air turbine starter of claim 1, wherein the unitary inlet structure is manufactured from a Titanium alloy.

3. The air turbine starter of claim 1, wherein the unitary inlet structure coupled to the main housing defines a flow path from the air inlet, through the stator, through the blades of the turbine wheel, and to the outlet vent.

4. The air turbine starter of claim 1, wherein the stator is characterized by a central circular body with a plurality of angularly spaced circumferentially mounted stator fins.

5. The air turbine starter of claim 4, wherein each stator fin presents an angle of attack of about 36.738 degrees.

6. The air turbine starter of claim 4, wherein the angular spacing of the stator fins is symmetrical.

7. The air turbine starter of claim 1, wherein the stator is characterized by a central circular body with a plurality of asymmetrically angularly spaced circumferentially mounted stator fins.

8. The air turbine starter of claim 7, wherein the stator fins are subdivided into at least three groups;

a first group substantially equally angularly spaced for about the total number of stator fins plus at least one, the spaced arrangement forming a first arc having a first and second end;

a second group substantially equally angularly spaced for about the total number of stator fins minus at least one, the spaced arrangement forming a second arc having a first and second end; and

a transition group characterized by an even number of stator fins substantially equally angularly spaced for about the total number of stator fins;

wherein one half of the transition group is placed between the second end of the first arc and the first end of the second arc, and the second half of the transition group is placed between the second end of the second arc and the first end of the first arc, thereby joining the first and second arcs to substantially form a circle.

9. The air turbine starter of claim 7, wherein the stator is comprised of 29 stator fins.

10. The air turbine starter of claim 9, wherein the angular spacing of stator fins 1 through 14 is based on substantially equivalent spacing for about 30 stator fins, the angular spacing of fin 15 is based on spacing for about 29 fins, the angular spacing of stator fins 16 through 28 is based on substantially equivalent spacing for about 28 stator fins, and the angular spacing of fin 29 is based on spacing for about 29 fins.

11. An air turbine starter unitary inlet structure comprising:

an annular housing having a longitudinal centerline, an air inlet, an inner surface, and a mounting surface; and

an annular air director integrally formed as part of the annular housing, the air director disposed at least partially within the annular housing and having an outer surface,

wherein at least a portion of the annular housing inner surface and the air director outer surface form a flow path that extends substantially parallel to the longitudinal centerline.

12. The unitary inlet structure of claim 11, wherein the annular air director is substantially concentric to the longitudinal centerline.

13. The unitary inlet structure of claim 11, wherein the annular air director is a stator characterized by a central circular body with a plurality of angularly spaced circumferentially mounted stator fins.

14. The unitary inlet structure of claim 13, wherein the spacing of the stator fins is symmetric.

15. The unitary inlet structure of claim 13, wherein the spacing of the stator fins is asymmetric.

16. The unitary inlet structure of claim 11, manufactured from a Titanium alloy.

17. A Titanium air turbine starter unitary inlet structure comprising:

a housing having a longitudinal centerline, an air inlet, an inner surface, a mounting surface, the annular housing defining a flow path between the air inlet and the mounting surface; and

a stator integrally formed as part of the housing, the stator disposed at least partially within the housing between the inlet and mounting surface and substantially transverse to the longitudinal centerline.

18. The unitary inlet structure of claim 17, wherein the stator is characterized by a central circular body with a plurality of angularly spaced circumferentially mounted stator fins.

19. The unitary inlet structure of claim 18, wherein each stator fin presents an angle of attack of about 36.738 degrees.

20. The unitary inlet structure of claim 18, wherein the angular spacing of the stator fins is symmetrical.

21. The unitary inlet structure of claim 17, wherein the mounting surface further comprises at least one attacher.

22. The unitary inlet structure of claim 21, wherein the at least one attacher is a threaded screw socket.

23. The unitary inlet structure of claim 17, wherein the stator is characterized by a central circular body with a plurality of asymmetrically angularly spaced circumferentially mounted stator fins.

24. The unitary inlet structure of claim 23,wherein the stator fins are subdivided into at least three groups;

a first group substantially equally angularly spaced for about the total number of stator fins plus at least one, the spaced arrangement forming a first arc having a first and second end;

a second group substantially equally angularly spaced for about the total number of stator fins minus at least one, the spaced arrangement forming a second arc having a first and second end; and

a transition group characterized by an even number of stator fins substantially equally angularly spaced for about the total number of stator fins;

wherein one half of the transition group is placed between the second end of the first arc and the first end of the second arc, and the second half of the transition group is placed between the second end of the second arc and the first end of the first arc, thereby joining the first and second arcs to substantially form a circle.

25. The unitary inlet structure of claim 23, wherein the stator is comprised of 29 stator fins.

26. The unitary inlet structure of claim 25, wherein the angular spacing of stator fins 1 through 14 is based on substantially equivalent spacing for about 30 stator fins, the angular spacing of fin 15 is based on spacing for about 29 fins, the angular spacing of stator fins 16 through 28 is based on substantially equivalent spacing for about 28 stator fins, and the angular spacing of fin 29 is based on spacing for about 29 fins.

27. The unitary inlet structure of claim 25, wherein the angular spacing of stator fins 1 through 14 is about 12.0000 degrees, the angular spacing of stator fin 15 is about 12.4286 degrees, the angular spacing of stator fins 16 through 28 is about 12.8571 degrees, and the angular spacing of stator fin 29 is about 12.4286 degrees.

28. A method of manufacturing a Titanium air turbine starter unitary inlet structure comprising:

casting a unitary inlet structure from an alloy, the unitary inlet structure including:

an oversized annular housing having a longitudinal centerline, at least an air inlet and a mounting surface, and

an oversized stator integrally formed as part of the oversized annular housing, the oversized stator disposed at least partially within the housing and having a plurality of angularly spaced, circumferentially mounted oversized stator fins connecting the stator to the annular housing;

chemically milling the oversized housing and stator to remove alloy from the oversized surfaces thereof;

measuring the clearance between the chemically milled stator fins and comparing the measurements to one or more predetermined values;

repeating the chemical milling and measuring steps until at least the measured clearance between the chemically milled stator fins is substantially equal to one or more predetermined values.

29. The method of claim 28, wherein the stator is transverse to and concentric with the longitudinal centerline.

30. The method of claim 28, wherein the alloy is a Ti6Al4V.

31. The method of claim 28, wherein the angular spacing of the stator fins is symmetrical.

32. The method of claim 28, wherein the angular spacing of the stator fins is asymmetrical.